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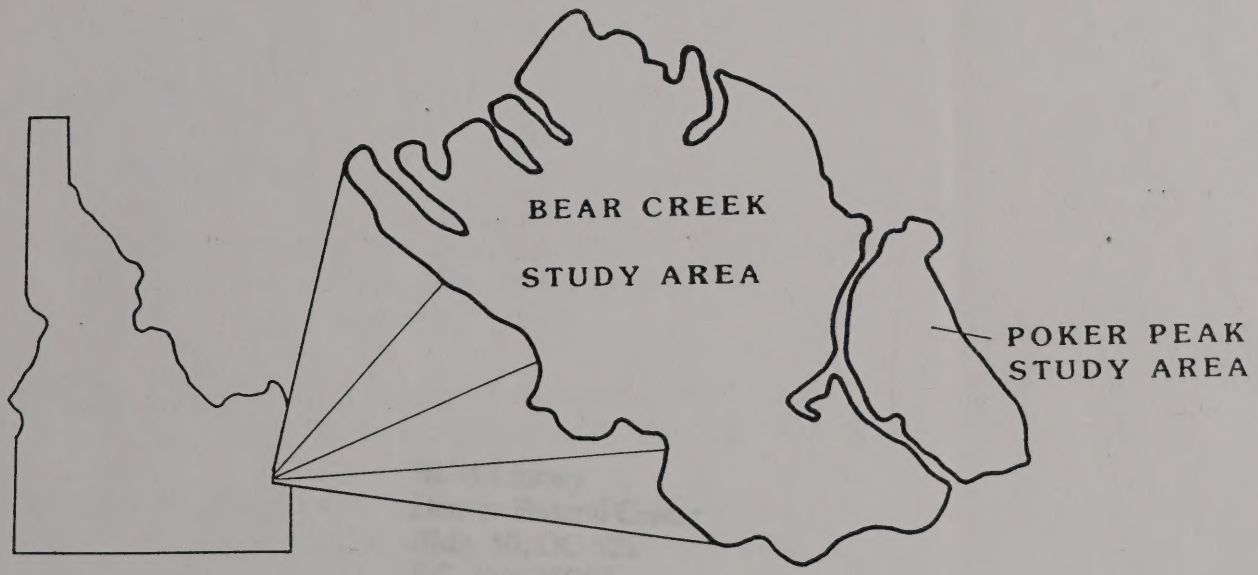
Mineral Resource Investigation of the Bear Creek-Poker Peak Study Area, Bonneville County, Idaho



BUREAU OF MINES

UNITED STATES DEPARTMENT OF THE INTERIOR

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PREFACE

The Wilderness Act (Public Law 88-577, September 3, 1964) and related acts require the U.S. Bureau of Mines and the U.S. Geological Survey to survey certain areas of Federal lands ". . . to determine the mineral values, if any, that may be present . . ." Results must be made available to the public and be submitted to the President and Congress. This report presents the results of a Bureau of Mines mineral survey of the Bear Creek-Poker Peak study area, Bonneville County, ID, which was classified as Non-Wilderness Recommended during the Second Roadless Area Review and Evaluation (RARE II) by the Forest Service, January 1979. Subsequent legislative proposals have recommended portions of the study area be classified as Wilderness. Mining-related activities in the study area would be severely restricted under Wilderness designation.

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This open-file report contains data gathered and interpreted by personnel of the U.S. Bureau of Mines, Western Field Operations Center, Branch of Resource Evaluation, East 360 Third Avenue, Spokane, WA 99202. This report has been approved by the Branch of Mineral Land Assessment, Washington, D.C.

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UNIT OF MEASURE ABBREVIATIONS USED IN THIS REPORT

ft^3	cubic foot
yd^3	cubic yard
ft	foot
in.	inch
mi	mile
ppb	part per billion
ppm	part per million
%	percent
lb	pound
lb/yd^3	pound per cubic yard
oz	troy ounce
oz/ton	troy ounce per ton

SUMMARY

In 1991, the USBM (U.S. Bureau of Mines) evaluated the mineral resources of the 174,550-acre Bear Creek-Poker Peak area. Located 40 air miles east from Idaho Falls, ID, the study area is in the Caribou National Forest but is mostly administered by Targhee National Forest. USBM personnel mapped and sampled mines, prospects, and mineralized sites in and near the study area.

Five types of mineral occurrences were identified in the study area: phosphate, limestone and travertine, placer gold, coal and uranium (the latter contained in the coal), and oil and gas. The study area has a high potential for oil and gas; evaluation of these commodities were beyond the scope of this study.

Phosphate has been mined continuously in Idaho since 1909. Although there has been no production of phosphate from the study area, the phosphate beds in the northeastern portion of the study area have been thoroughly studied and resource estimates made by various individuals. These estimates range from 30 million tons to 3.9 billion tons, with grades ranging from 18% to 30% P_2O_5. Resource estimates vary widely because of different parameters used in making the calculations. Some of the phosphate in the study area is the thickest (12.7 ft) and highest grade (33.4% P_2O_5) in the western phosphate field.

Placer gold has been mined intermittently from the 1860's to the present from the Mt. Caribou (Mt. Pisgah) mining district along McCoy Creek, the southern boundary of the study area. USBM records indicate that 275 oz of gold were recovered from 66,000 yd^3 of gravel, but there was also additional unrecorded production. A U.S. Forest Service patent examination of three claims on McCoy Creek reported 7,203,152 yd^3 of gravel containing from \$0.03 to \$0.08/yd^3 (\$353 gold) which is uneconomic. Samples collected by USBM personnel averaged \$0.33/yd^3 (\$353 gold). The average value for placer gold mines in the United States is about 0.03 ounce/yd^3 (\$10.60/yd^3) washed.

Idaho Travertine Corporation has operated a travertine quarry adjacent to the northern tip of the study area since 1957. The travertine is used for dimension stone in the building industry throughout the United States. Production depends on market conditions and may be up to 70,000 ft^3 per year of stone. Resource estimates for the quarry are 150 million ft^3 of travertine and the company estimates about 100 years of reserves remain.

A reported 4-ft-thick coal seam in the study area was explored by a 98-ft adit in 1922, but there was no production. The coal deposit is too small and low grade to compete with present day large-scale producers. In the 1950's the USGS (U.S. Geological

Survey) determined that the coal bed contains an estimated 6.5 million tons of material grading 0.02% uranium. This resource is partially in the northwestern portion of the study area.

The Western Overthrust Belt has long been an exploration target for oil and gas. Two wells were drilled near the Bear Creek-Poker Peak boundary, in the study area, in 1949 and 1963. Several wells have been drilled near the study area, but all have been plugged and abandoned. Six oil and gas leases in the study area expired in 1991.

INTRODUCTION

The USBM investigated the mineral resources of the Bear Creek and Poker Peak roadless areas in Idaho, near Alpine, Wyoming, in 1991. In a U.S. Senate Bill (100th Congress) these areas were referred to as parts of the proposed Palisades Wilderness, and a similar House Bill refers to them as the Bear Creek and Poker Peak proposed Wilderness. Similar proposals were made in the 101st Congress. The USBM examined individual mines, prospects, claims, and mineralized zones. Although the immediate goal of this and other USBM surveys is to provide data to the President, Congress, government agencies, and the Public for land-use decisions, the long-term objective is to ensure the Nation has an adequate and dependable supply of minerals at reasonable economic and environmental costs.

Setting

The study area is in southeastern Idaho, about 40 air miles east of Idaho Falls, ID, just west across Palisades Reservoir from Alpine, WY (fig. 1). The area includes the 95,850-acre Bear Creek unit (RARE II no. 04615) and the 18,600-acre Poker Peak unit (RARE II no. 04616) in the Caribou National Forest. All of the Poker Peak study area and 78,700 acres of the Bear Creek study area are administered by the Targhee National Forest. The study area is approximately bounded by FS (Forest Service) Road 058 on the northeast (parallel to the Snake River), the Fall Creek Road (FS 077) on the northwest, the Skyline Road (FS 077) on the southwest, the McCoy Creek Road (FS 087) on the south, and Palisades Reservoir on the west. The Bear Creek-Jensen Pass Road (FS 058) separates the two study areas (fig. 2).

The highest point in the Bear Creek unit is 9,476-ft Big Elk Mountain and the highest point in the Poker Peak unit is 8,439-ft Poker Peak. The lowest point in the study area is where Fall Creek exits the Bear Creek unit at 5,400 ft elevation. Most of the study area is forested with fir, pine, and aspen, but there are large alpine meadows and sagebrush flats in many places. The topography is rolling to steep, making access fairly easy in most of the study area.

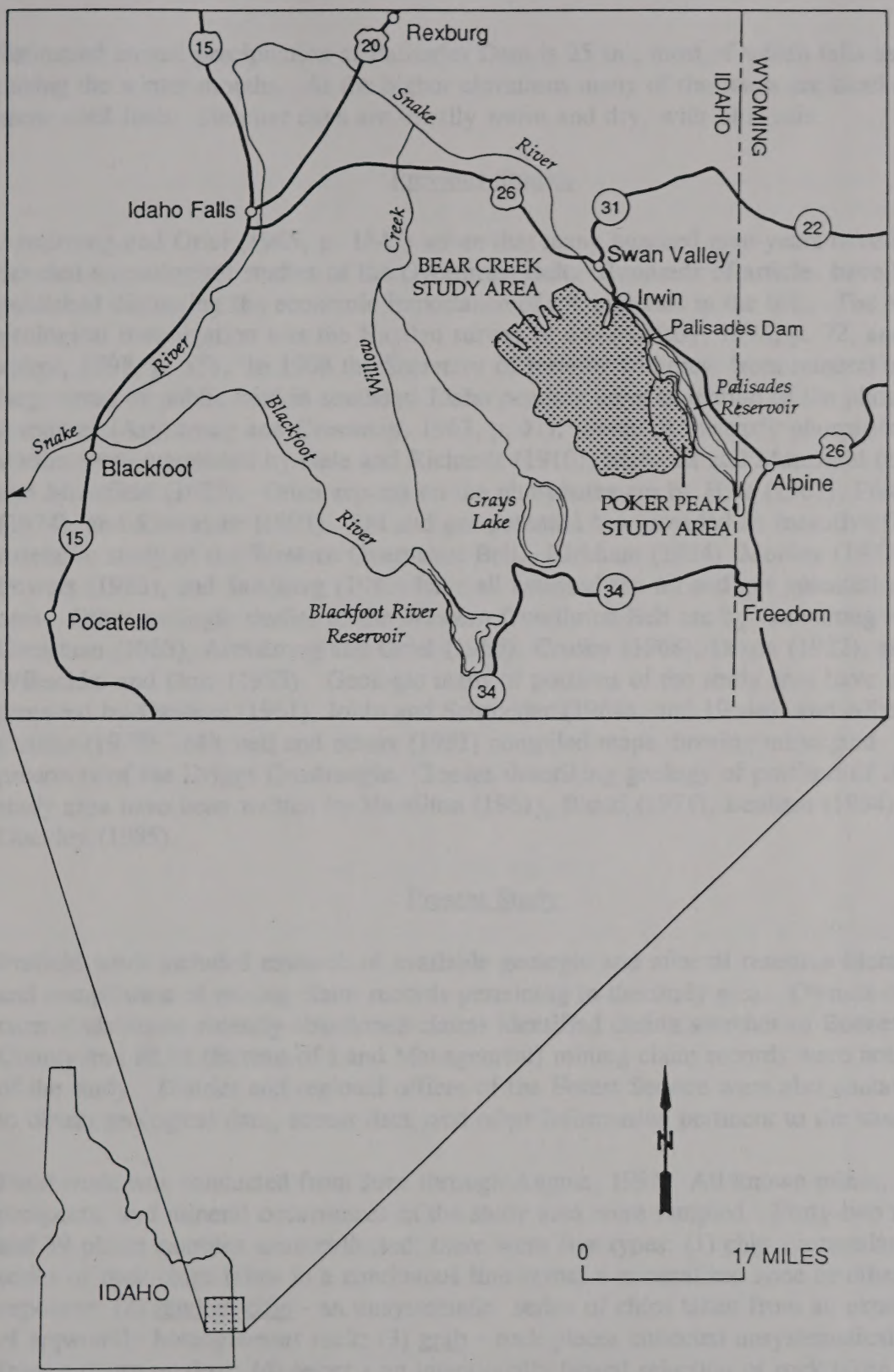
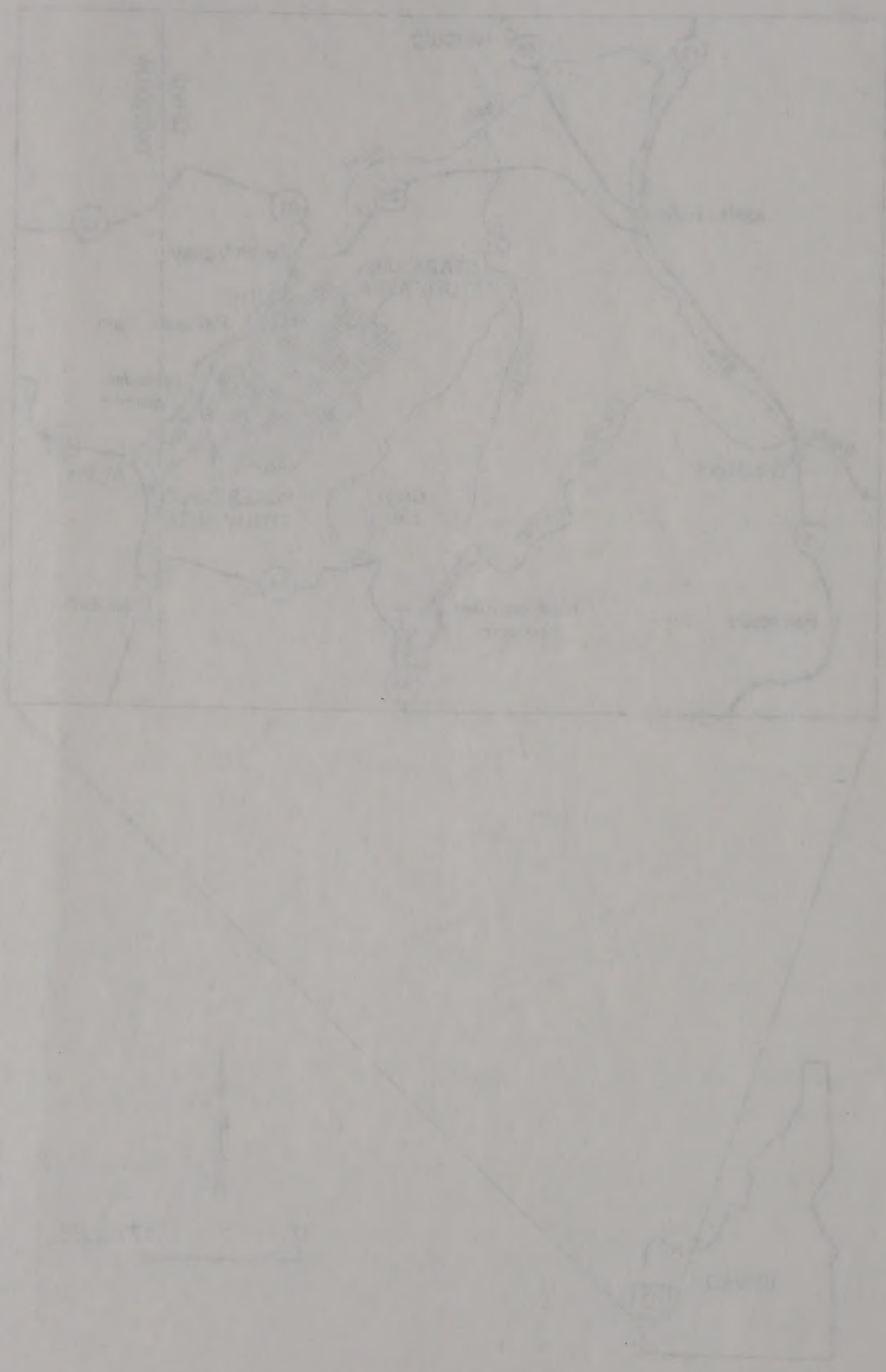


Figure 1.- Location of the Bear Creek-Poker Peak study area, Bonneville County, ID



Estimated annual precipitation at Palisades Dam is 25 in., most of which falls as snow during the winter months. At the higher elevations many of the roads are blocked by snow until June. Summer days are usually warm and dry, with little rain.

Previous Studies

Armstrong and Oriel (1965, p. 1847) wrote that many hundred man-years have been devoted to geological studies of the Overthrust Belt. Hundreds of articles have been published discussing the economic importance of the minerals in the belt. The earliest geological investigation was the Hayden survey of 1877 (Kirby, 1898, p. 72, and Lakes, 1898, p. 55). In 1908 the Secretary of Interior withdrew from mineral entry large areas of public land in southeast Idaho pending an examination of the phosphate resources (Armstrong and Cressman, 1963, p. J1). Some of the early phosphate studies were completed by Gale and Richards (1910), Richards and Mansfield (1914), and Mansfield (1927). Other reports on the phosphates are by Hale (1967), Powell (1974), and Stowasser (1991). Oil and gas potential has provided an incentive for extensive study of the Western Overthrust Belt. Kirkham (1924), Monley (1971), Powers (1983), and Sandberg (1983) have all assessed the oil and gas potential of this area. Other geologic studies of the Western Overthrust Belt are by Armstrong and Cressman (1963), Armstrong and Oriel (1965), Crosby (1968), Dixon (1982), and Wiltschko and Dorr (1983). Geologic maps of portions of the study area have been prepared by Gardner (1961), Jobin and Schroeder (1964a, and 1964b), and Albee and Cullins (1975). Mitchell and others (1981) compiled maps showing mines and prospects of the Driggs Quadrangle. Theses describing geology of portions of the study area have been written by Hamilton (1961), Bhatti (1971), Benham (1984), and Gockley (1985).

Present Study

Prefield work included research of available geologic and mineral resource literature and compilation of mining claim records pertaining to the study area. Owners of current claims or recently abandoned claims identified during searches of Bonneville County and BLM (Bureau of Land Management) mining claim records were notified of the study. District and regional offices of the Forest Service were also contacted to obtain geological data, access data, and other information pertinent to the study.

Field work was conducted from June through August, 1991. All known mines, prospects, and mineral occurrences in the study area were sampled. Forty-two rock and 39 placer samples were collected; there were five types: (1) chip - a regular series of rock chips taken in a continuous line across a mineralized zone or other exposure; (2) random chip - an unsystematic series of chips taken from an exposure of apparently homogeneous rock; (3) grab - rock pieces collected unsystematically from a dump or float; (4) select - an intentionally biased selection of rock taken

because of a unique or unusual property; (5) reconnaissance pan - two 14-in. diameter gold panfuls, usually stream sand and gravel, in which the heavy mineral fraction is concentrated by panning.

The rock samples were analyzed for a 11-element[1] geochemical suite using the inductively coupled plasma (ICP) method to detect elements of possible significance, and for gold by fire assay with an atomic absorption finish. Elements identified in the field were also analyzed by atomic absorption spectrometry methods to determine their economic potential.

Placer samples, partially concentrated in the field, were further concentrated on a laboratory-size Wilfley table at the USBM Western Field Operations Center office. After concentration, the placer samples were examined using a microscope, and all visible gold was removed by hand. The samples were bathed in nitric acid to remove iron oxide stains on any remaining gold and then amalgamated with mercury. The degree of rounding of the gold was determined by comparison to Compton (1962) to help determine if the gold had been transported and, if so, how far from its source. Heavy mineral fractions were scanned with a binocular microscope to determine the types and quantities of heavy minerals present. A gold price of $353/oz (Engineering and Mining Journal, 1991, p. 138) was used in all calculations except were noted.

The oil and gas resource potential of the study area is only summarized in this report; it has been evaluated in detail by the USGS. In addition, only cursory sampling of the phosphate beds was done to check for possible by-product minerals; evaluation of the phosphate resources is adequately covered in references cited in this report.

ACKNOWLEDGEMENTS

The author was assisted in the field by Robert J. Ristow, Jr.. Chuck Horsburgh, BLM geologist, Idaho Falls District Office, provided information on oil and gas leases in the study area. Ted Orchard, owner of Idaho Travertine, gave an overview of the dimension stone market in the United States and provided information on the Fall Creek travertine deposit.

GEOLOGIC SETTING

The Bear Creek-Poker Peak study area is in the Idaho-Wyoming Thrust Belt, which is a small part of the much larger Overthrust Belt that stretches from Alaska to Central America (Maley, 1987, p. 96). The Idaho-Wyoming Thrust Belt is a tectonic province characterized by Paleozoic and Mesozoic-age marine and clastic sedimentary

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[1] Antimony, arsenic, barium, copper, lead, manganese, mercury, molybdenum, silver, tungsten, zinc

rocks that have undergone extensive folding, thrusting, and normal faulting. Estimated maximum thicknesses of sediments for the belt range from 50,000 ft (Crosby, 1968, p. 2000) to 100,000 ft (Armstrong and Oriel, 1965, p. 1849). Based on isopach maps by Monley (1971), thickness of sediments in the study area is about 17,000 ft, deposited mostly during the Cretaceous Period.

Thrust faulting and folding associated with the Sevier Orogeny started in the Late Jurassic-Early Cretaceous and lasted to the Eocene (Wiltschko and Dorr, 1983, p. 1309-1313). During the Sevier Orogeny the Idaho-Wyoming Thrust Belt was compressed horizontally about 65 mi (Maley, 1987, p. 99), with a stratigraphic throw of about 20,000 ft (Armstrong and Oriel, 1965, p. 1847) by as many as seven major and numerous minor westward dipping thrust faults. The Bear Creek-Poker Peak study area lies between the Crawford-Meade and the Absaroka thrust faults; the Box Canyon (Albee and Cullins, 1975) and Deer Creek thrust faults crosscut the study area.

Following the Sevier Orogeny, Basin and Range faulting started in the Eocene and has continued to the present. Monley (1971, p. 525) states that the Basin and Range faults may be normal faults, or they represent reversed movement on the older thrust faults.

Five types of mineral occurrences were identified in the study area; 1) phosphate, 2) limestone-travertine, 3) gold placer, 4) coal with minor accessory uranium, and 5) oil and gas. The Permian-age Phosphoria Formation, which hosts the phosphate-bearing shales in southeastern Idaho, is exposed in two blocks in the study area. These two blocks make up the KPLA (Known Phosphate Leasing Area) serial number I 20416. In the Fall Creek block, (figs. 2 and 3) phosphate is exposed continuously for more than 8 mi, from Little Currant Hollow southeast to Deer Creek, where it is offset by the Deer Creek thrust fault. The bed is in a southwest limb of a southeast-plunging anticline. Smart and others (1954, p. 5-6) measured the thickness of the phosphate-bearing shale at 53.4 ft. and total thickness of the Phosphoria Formation at 194.9 ft (SW 1/4 sec. 18, T. 1 N., R. 43 E.). The other lease block, the Bear Creek, (figs. 2 and 4) is exposed from the thrust fault in the Deer Creek area to Bear Creek 3.5 mi to the southeast. Sheldon (1963, p. 153) reports these beds are the thickest and highest grade (12.7 ft and 33.45% P_2O_5) in the western phosphate field. These phosphate-bearing beds are generally thicker, 61.9 ft (Smart and others, 1954, p. 11-13), and of higher grade than the Fall Creek beds, due to more complex faulting and folding, which thickened the sequence, and fracturing which allowed weathering processes to enrich the phosphate near the surface (Service, 1966, p. 176). Total thickness at this location was measured at 92.2 ft in the NE 1/4 sec. 31, T. 1 S., R. 45 E. (Smart and others, 1954, p. 11-12).

Carbonate rocks in the study area include impure, silty, and sandy dolomite and limestone as well as travertine containing about 98.8% $CaCO_3$ (calcium carbonate). In the Fall Creek area (fig. 2), the travertine was deposited from hot springs probably associated with volcanic activity on the Snake River Plain (Neumann, 1991, p. 60) to the north. The Draney and Twin Creek Limestones are the primary carbonate-bearing formations in the study area.

Placer gold deposits are restricted to McCoy Creek along the southern boundary of the study area (fig. 5). The auriferous gravels were derived from gold skarn deposits near Mt. Caribou, 4 to 5 mi south of the study area. Gravels nearer the source areas contain higher percentages of igneous (andesite and diorite) and metamorphic rock fragments, while gravels farther downstream contain higher percentages of sedimentary rock fragments. Most of the rocks in the gravels are well rounded, and 18 in. or less in diameter. The gravels are poorly sorted and contain enough clay to hinder gold recovery. The sedimentary bedrock is dipping steeply making natural traps for the gold. Gold particles range in size from 1/4 in. to flour; most pieces are somewhat flattened.

Coal deposits in the study area occur in the Cretaceous Wayan Formation located in a tightly folded and faulted anticline (Savage, 1961, p. 66) along Fall Creek. The coal forms thin zones of incompetent strata which has been sheared by differential movement between the overlying and underlying competent beds (Vine and Moore, 1952, p. 4). Small amounts of uranium are present in the coal; Vine and Moore (1952, p. 10) suggest that the uranium percolated in solutions downward from siliceous volcanics to carbonaceous material which adsorbed it.

Folding and faulting caused by thrusting in the Idaho-Wyoming Thrust Belt has formed numerous subsurface structures or traps which may contain oil and gas. The Nugget Sandstone and the Twin Creek Limestone, where folded into anticlines with overlying traps, are possible sources for oil and gas. One such structure is the doubly-plunging Big Elk anticline (Gockley, 1985, p. 26).

APPRAISAL OF COMMODITIES EXAMINED

The literature search found resource estimates made by the USBM and USGS for phosphate. Those resource estimates are used in this report; a field examination was made to familiarize the author with the phosphate occurrences and to allow sampling for possible by-product minerals. The placer gold resource estimate is from a Forest Service patent examination of three claims on McCoy Creek. The rest of McCoy Creek was examined by USBM personnel. Commodities including individual properties are discussed in the following section.

Phosphate

Within the study area the phosphate-bearing shales occur in the Meade Peak Member of the Phosphoria Formation. The Meade Peak Member is overlain by the Rex Chert Member, and is underlain by the Grandeur Member of the Phosphoria Formation. Smart and others (1954, p. 5-6) and Sheldon (1963, p. 167-171) have described numerous different thin beds (some less than 1 ft) in the Meade Peak Member, but Jobin (1966, p. 69) has grouped the beds into three different horizons. Typically, thin phosphate-bearing beds of high- to medium-grade occur in the basal 15 to 20 ft of the member, in a single bed of low- to moderate-grade near the center, and in one or more beds of high- to moderate-grade in the upper 3 to 12 ft. Outcropping in the two lease blocks, the Meade Peak Member is exposed from Garden Creek (4 mi northwest of the study area) to the thrust fault in the Deer Creek area and north of Bear Creek. The Phosphoria Formation in the Fall Creek block (figs. 2 and 3) can be traced for 12 mi (8 mi within the study area) along the southwest limb of a southeast-plunging anticline. The formation in this block is 195 ft thick (Smart and others, 1954, p. 6). The beds dip as steep as 75° SW (Gere and Hite, 1956, p. 5) but average about 30° to 45°. Jobin (1967, p. 71) reports that the upper units of the Meade Peak Member contain 3.0- to 5.5-ft-thick beds of phosphate-bearing shales averaging 29.4% to 33.3% P_2O_5, and the lower units contain 3.0- to 3.8-ft-thick beds with average assays ranging from 26.5% to 29.5% P_2O_5. East of the thrust fault, in the Bear Creek block, (figs. 2 and 4) the phosphate-bearing shales thicken to as much as 92.2 ft (Smart and others, 1954, p. 11-12), and the grade increases due to complex folding and faulting. Jobin (1967, p. 71) reports the upper beds of phosphate-bearing shale average 6.0 ft thick and 33.3% P_2O_5 and that the lower bed averages 8 ft thick, with 28% P_2O_5.

Sears (1955, p. 1,680) reported that Phillips Petroleum Company dug 20 trenches across the shale unit. Service (1966, p. 175) reported that in 1955 E. A. Rex Mining Corporation controlled 44 unpatented mining claims, and that a 150-ft adit (north of Fall Creek) (fig. 3) was driven in 1958-59. In 1959 the company acquired four phosphate leases (I-06433, I-06638, I-010763, and I-010764) in the Caribou Range KPLA. The leases were optioned by Wells Cargo Inc., which in 1960 and 1964 trenched the phosphate shales. In 1964 FMC explored the northern portion of the leases by drilling and driving an adit. In 1974 Western Cooperative Fertilizers Ltd., the current owner, obtained the properties. From 1974 to 1976, the cooperative contracted with the Anaconda Company to develop and mine the phosphate north of Fall Creek. Since 1976 no work has been done on the four phosphate leases.

Sheldon (1963, p. 154), Service (1966, p. 9 and 1967, p. 94), Jobin (1967, p. 71), and an unpublished company report have each made ore estimates for the phosphate shales in the study area. The estimates range from 30 million tons with an average grade of 30% P_2O_5 to 3,897.7 million tons which includes all phosphate-bearing shales containing more than 18% P_2O_5. The wide range of resource estimates is due

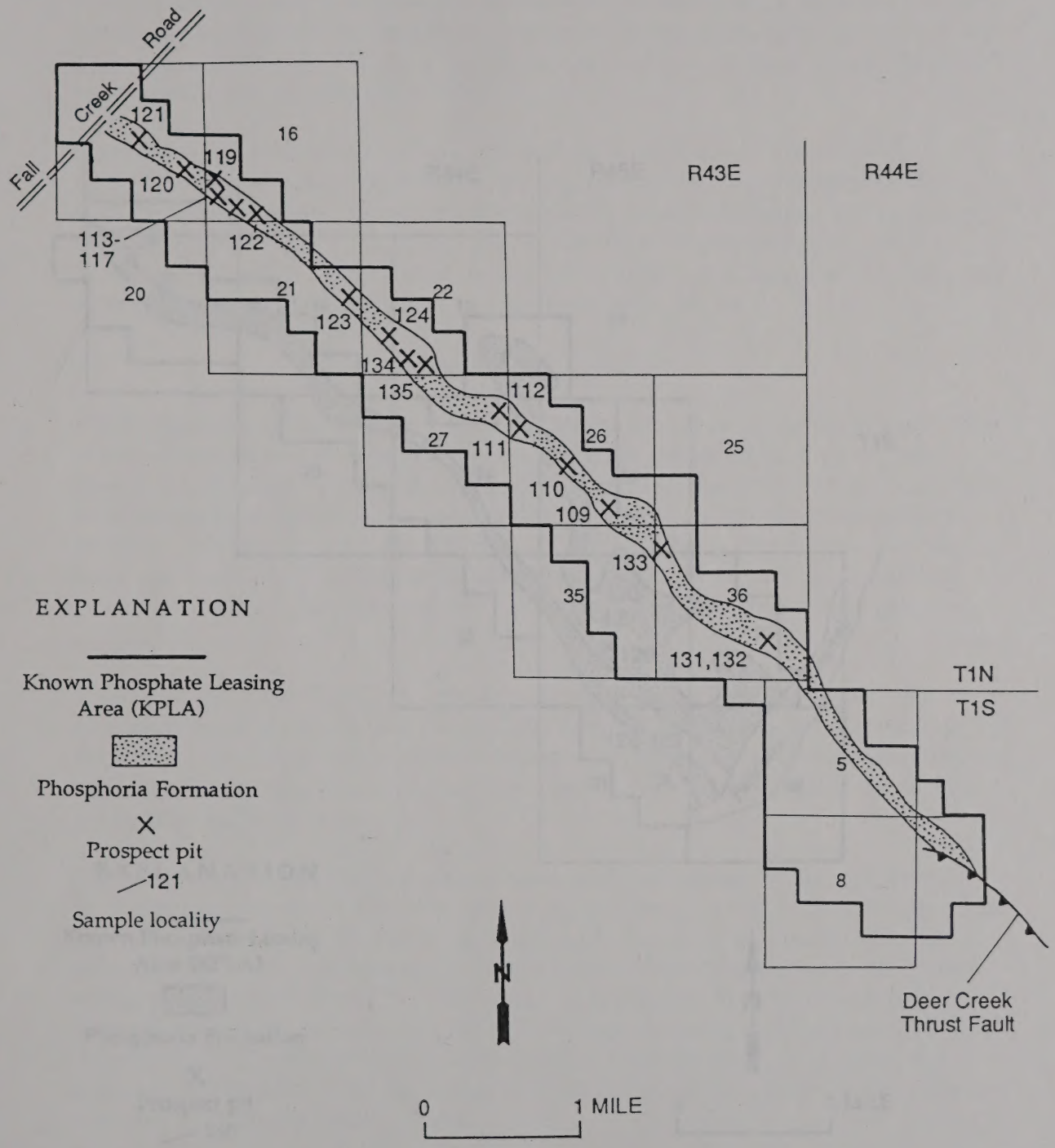


Figure 3.- Phosphate sample localities in the Fall Creek lease block

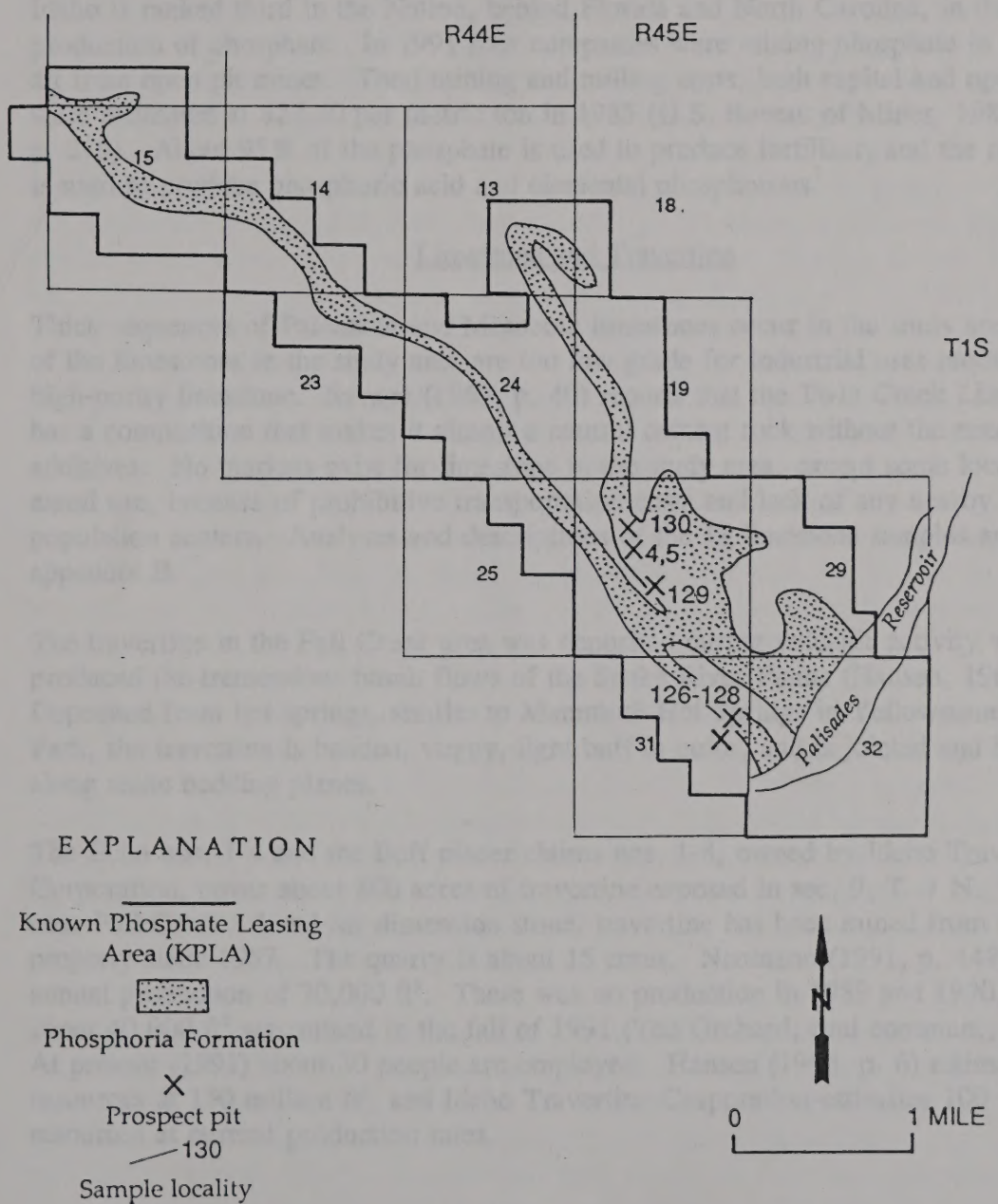
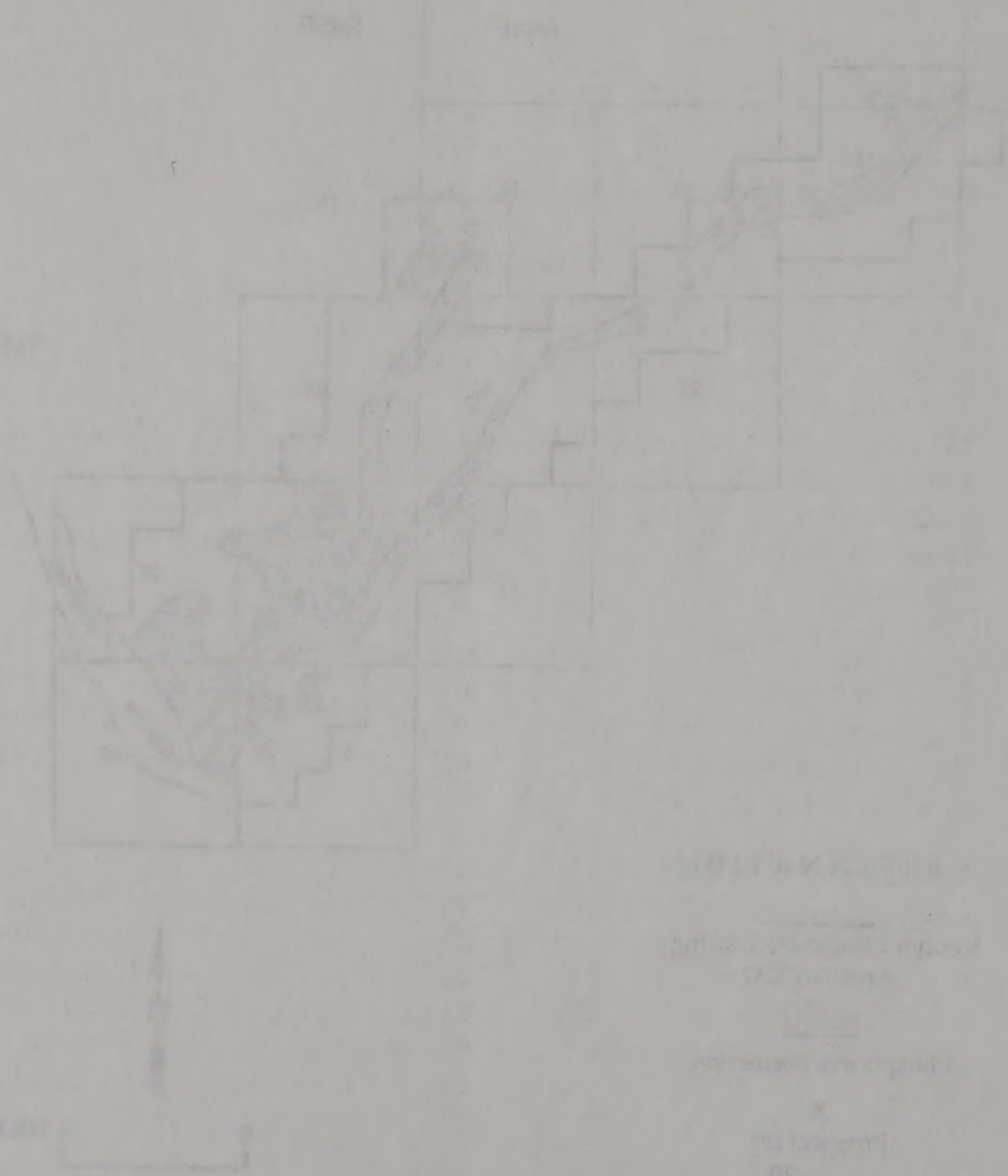


Figure 4.- Phosphate sample localities in the Bear Creek lease block



to different uses of the estimates. The smallest is by a mining company which considered only phosphate "reserves". See U.S. Bureau of Mines, and U.S. Geological Survey (1982, p. 4) for definition of reserves. The largest figure was an effort to determine how much phosphate exists in the KPLA. The estimates in between are comparable with the others, but used different mining depths and cutoff grades, depending on either surface or underground mining methods. Because of the steep dip of the Meade Peak Member phosphate-bearing beds, only a small portion of it could be mined by open pit methods.

Idaho is ranked third in the Nation, behind Florida and North Carolina, in the production of phosphate. In 1991 four companies were mining phosphate in the State, all from open pit mines. Total mining and milling costs, both capital and operating, were estimated at $27.40 per metric ton in 1985 (U.S. Bureau of Mines, 1987, p. 219). About 95% of the phosphate is used to produce fertilizer, and the remainder is used to produce phosphoric acid and elemental phosphorous.

Limestone and Travertine

Thick sequences of Paleozoic and Mesozoic limestones occur in the study area. Most of the limestones in the study area are too low grade for industrial uses requiring high-purity limestone. Savage (1969, p. 40) reports that the Twin Creek Limestone has a composition that makes it almost a natural cement rock without the need for additives. No markets exist for limestone in the study area, except some local road metal use, because of prohibitive transportation costs and lack of any nearby large population centers. Analyses and descriptions of the 11 limestone samples are in appendix B.

The travertine in the Fall Creek area was deposited during volcanic activity which produced the tremendous basalt flows of the Snake River Plains (Hansen, 1966, p. 1). Deposited from hot springs, similar to Mammoth Hot Springs in Yellowstone National Park, the travertine is banded, vuggy, light buff in color, and is jointed and broken along some bedding planes.

The Echo nos. 1-4 and the Buff placer claims nos. 1-8, owned by Idaho Travertine Corporation, cover about 800 acres of travertine exposed in sec. 9, T. 1 N., R. 43 E. near Fall Creek. Used for dimension stone, travertine has been mined from the property since 1957. The quarry is about 15 acres. Neumann (1991, p. 148) gives annual production of 70,000 ft^3. There was no production in 1989 and 1990, but about 40,000 ft^3 was mined in the fall of 1991 (Ted Orchard, oral commun., 1991). At present (1991) about 30 people are employed. Hansen (1966, p. 6) estimates resources at 150 million ft^3, and Idaho Travertine Corporation estimates 100 years of resources at current production rates.

The quarry is operated intermittently, depending on sales of dimension stone. The travertine is mined with a large bulldozer and a large track-mounted backhoe. No explosives are used to excavate the rock from the ground. A percussion drill and blasting cord are used to trim the blocks before they are trucked to Idaho Falls to be cut and polished to customer's specifications. Only about 8% to 10% of the material excavated is suitable for dimension stone. Idaho Travertine Corportion has about 5% of the U.S. market, the main competition coming from imported Italian marble (Ted Orchard, oral commun., 1991).

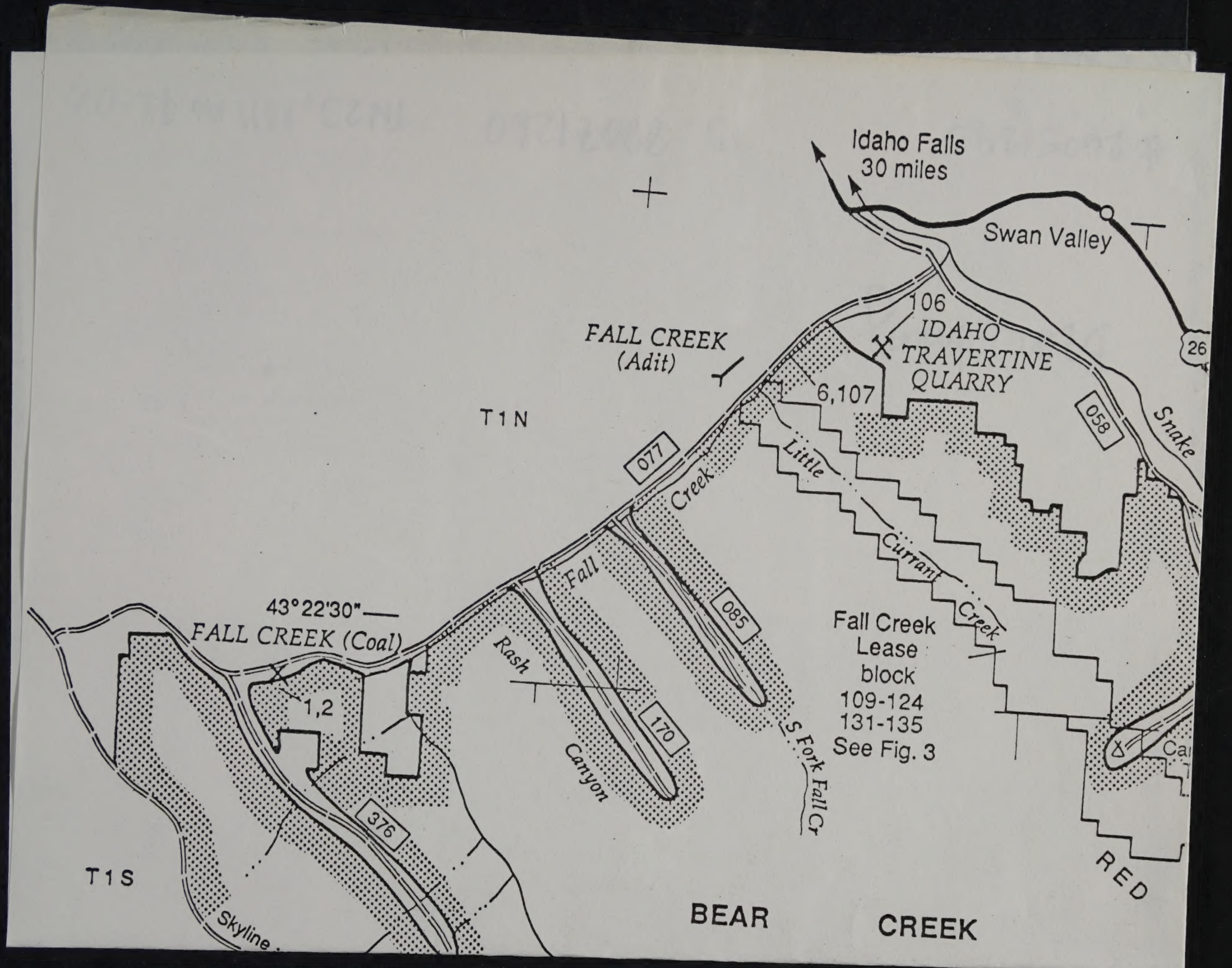
Placer Gold

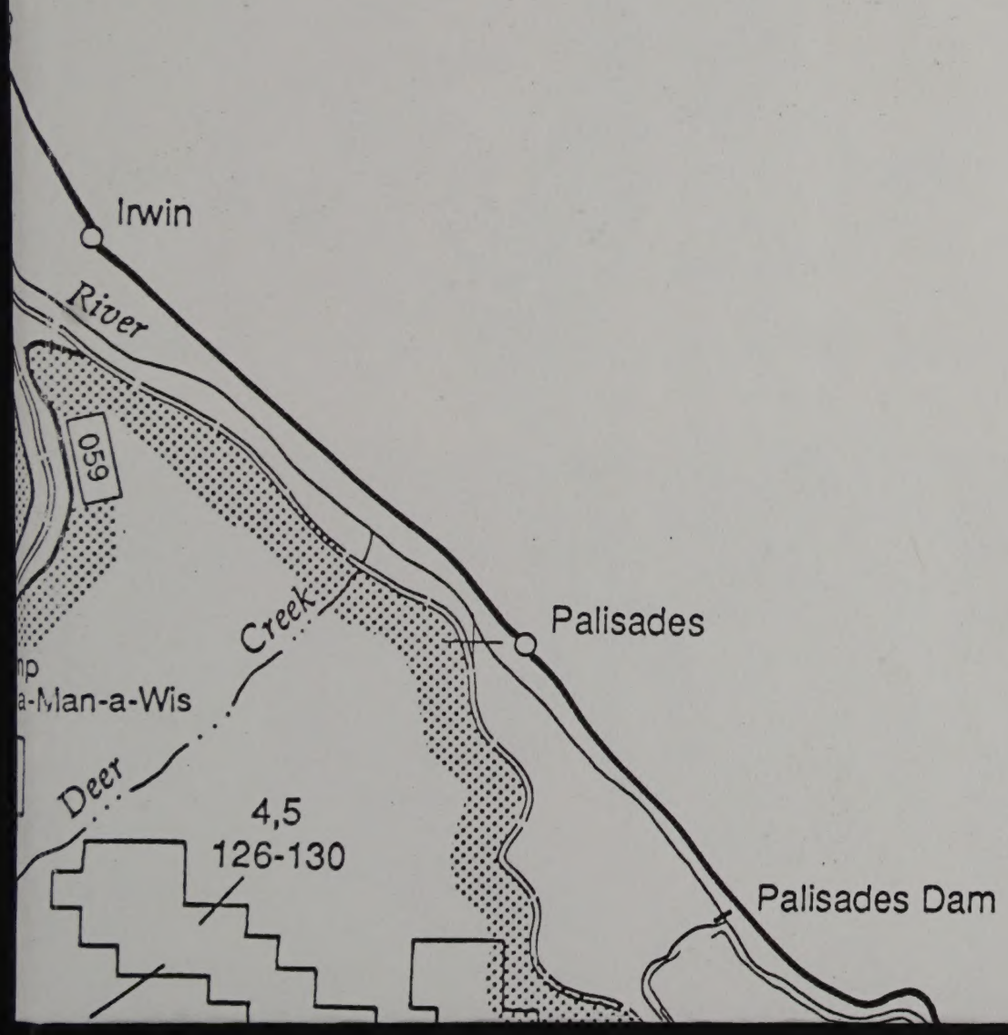
Placer gold mining occurred along McCoy Creek which is along the north edge of the Mt. Caribou (Mt. Pisgah) mining district and forms the southern boundary of the study area (fig. 5). Schultz (1918, p. 79) reported that gold mining started on McCoy Creek after 1860. It has continued spasmodically almost up to the present. Schultz and Richards (1913, p. 282) and Schultz (1918, p. 79) reported placer mining on McCoy Creek used sluice boxes and burlap-covered tables. During the late 1930's Caribou Gold Mining Co. worked the McCoy placer claims nos. 1-3. USBM files indicate that from 1934 to 1941, 274.97 oz of gold were recovered from 66,255 yd^3 of gravel from McCoy Creek drainage. In 1948 Everett Sloane formed the McCoy Creek Mutual Mining Association and divided the claims into four groups: Hard Luck, Sage, Ken, and Janet. In the early 1950's a dragline dredge with a trommel operated on McCoy Creek near the western border of the study area (Orville Divine, oral commun., 1991). Hamilton (1961, p. 47) noted the remains of a dredge on the creek. Tailings near the western border of the study area suggest that some portions of the creek have been dredged twice. Sundance Mining Company leased the claims in 1968. Orville "Eddie" Divine located the Mi-Oro claims on McCoy Creek in 1970.

In 1969 McCoy Creek Mutual Mining Association filed mineral patent applications with the U.S. Forest Service for the Sage, Ken, and Janet claims; the Hard Luck group was inundated by the Palisades Reservoir. The claims were examined by the Forest Service in 1979, and the patent was denied. The Forest Service estimated 7,203,152 yd^3 of gold-bearing gravel occurs with values ranging from \$0.03 to \$0.08/yd^3. The average value for placer gold mines in the United States is about 0.03 ounce/yd^3 (\$10.60/yd^3) washed (Lucas, 1988, p. 425). Sample locations are showed on fig. 5, and analyses are listed in appendix D.

Placer gravels along McCoy Creek show a wide variation in composition. Near the western border of the study, area about one-third of the gravels are of igneous and metamorphic origin, and the remainder are sedimentary. The percentage of sedimentary rock fragments increases downstream except where Iowa Creek empties into McCoy Creek. The non-sedimentary rock fragments have been transported about 4 mi downstream along Barnes and Iowa Creeks from Mt. Caribou, the source area of

Figure 2.- Prospects, quarries, known phosphate leasing areas, and oil wells in and near the Bear Creek-Poker Peak study area


Idaho Falls
30 miles
Swan Valley
106
IDAHO
TRAVERTINE
QUARRY
6,107
FALL CREEK
(Adit)
T1N
077
Little
Creek
058
26
Snake
Currant
Creek
Fall
Creek
085
43°22'30"
FALL CREEK (Coal)
1,2
Rash
170
Canyon
S Fork Fall Cr
Fall Creek
Lease
block
109-124
131-135
See Fig. 3
376
T1S
Skyline
BEAR
CREEK
RED


Irwin
River
059
Creek
Palisades
a-Man-a-Wis
Deer
4,5
126-130
Palisades Dam

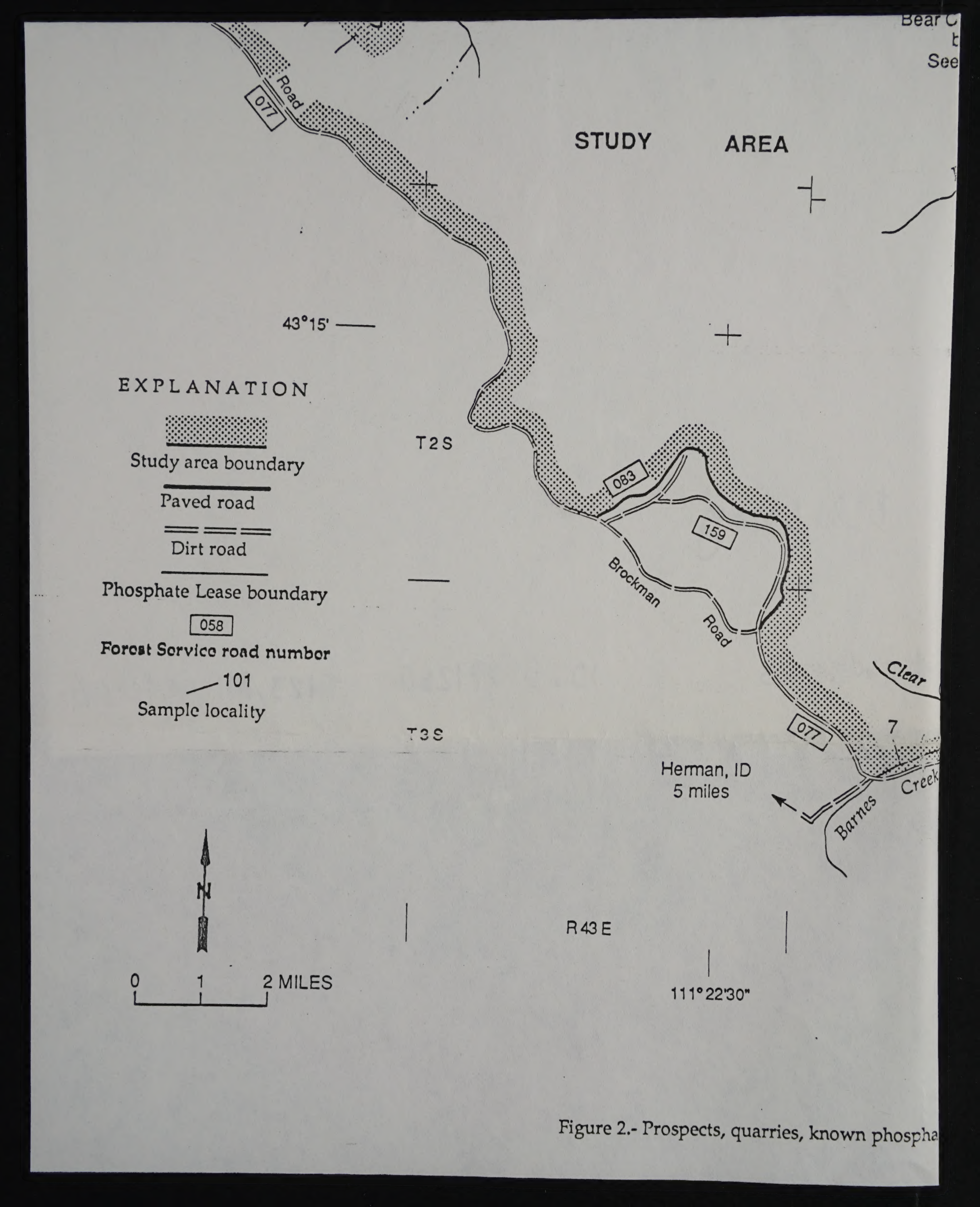


Figure 2.- Prospects, quarries, known phospha

eek Lease
lock
Fig. 4

RIDGE

101

125

Palisades
Reservoir

Normal
Elev 5620

POKER

PEAK

STUDY

AREA

104

105

3
103

Poker Peak
8439

Big Elk Mtn
9476

Oil Wells

Elk Creek

058

Jensen
Pass

Jensen Creek

102

108

Road

McCoy Creek

Wolverine Creek

See Fig. 5 for placer
gold localities

McCoy Creek

087

Iowa Cr

IDAHO

WYOMING

BONNEVILLE COUNTY

LINCOLN COUNTY

Alpine

89

R 44 E

R 45 E

R 46 E

111° 15'

111° 07'30"

e leasing areas, and oil wells in and near the Bear Creek-Poker Peak : udy area

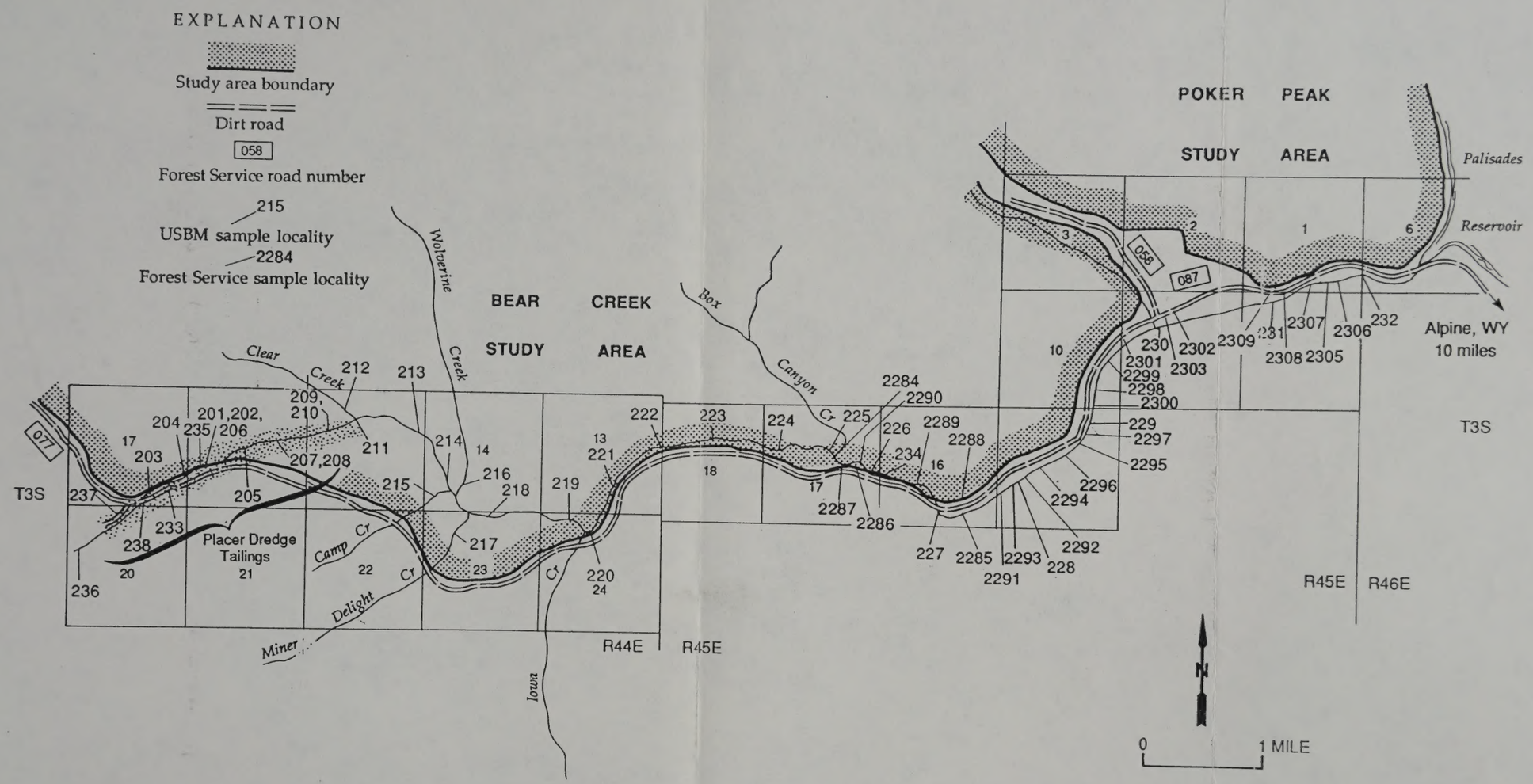


Figure 5.- Placer gold sample localities along McCoy Creek

the gold. The boulders are subrounded to well rounded, and most are under 18 in. in diameter. Bedrock is Mesozoic sedimentary rocks that have been tilted with dips ranging from 35° to near vertical. Reddish brown clay occurs along bedrock and in the dredge tailings. The clay is difficult to break up which may have caused low recovery rates from the dredge. This would explain why often more gold was recovered from samples of dredge tailings than from samples taken of stream gravels.

The gold in McCoy Creek ranges in size from flakes about 1/4 in. across to flour size. The gold is well rounded and flattened, indicating it is alluvial rather than colluvial. Gold from Barnes Creek is 960 fine (Hamilton, 1961, p. 45). The field examination found that the farther downstream, the smaller the size of the gold particles: this would explain why burlap-covered tables were used to recover gold at the mouth of McCoy Creek. Locations of placer samples collected by USBM personnel are on fig. 5, and sample descriptions are in appendix C.

Coal and Uranium

The Fall Creek Coal prospect, also known as the Joseph Smith mine or the God Send to Health mine, is in sec. 4, T. 1 S., R. 42 E., 12 mi on the Fall Creek road (FS 077) southwest of Swan Valley. A 98-ft adit was dug in 1922 by J. H. Smith (Vine, 1959, p. 267). The 4-ft thick seam of coal is in the upper Cretaceous Bear River Formation. The seam is described as sheared, coaly shale, and thin lenses of coal, clay, and limestone (Vine, 1959, p. 269). The coal seam occurs along the northeast limb of a faulted anticline (Vine and Moore, 1952, p. 4). Savage (1961, p. 66) reported the folding and faulting destroyed any original value that this coal may have had, and that the coal is too sparse and low grade to be of commercial value. One early investigator called this the "best" coal deposit in the area (Savage, 1961, p.66). The USBM investigation found the adit caved and only carbonaceous shale at the prospect.

A scintillometer reading of 80 cps (counts per second) was the highest reading obtained. Background readings were 20 to 30 cps. See appendix A for assays.

The USGS, on behalf of the U.S. Atomic Energy Commission, investigated uranium in the coal bed. Vine (1959, p. 255) reported a resource of 6.5 million tons with an average grade of 0.02% uranium. Vine and Moore (1952, p. 6) reported the top 1 ft of coal has an average grade of 0.045% uranium, and the ash grades 0.082% uranium. The uranium was transported by meteoric water percolating downward through mildly radioactive silicic volcanic rocks and concentrated in the carbonaceous material (Vine and Moore, 1952, p. 1).

Oil and Gas

The Idaho-Wyoming Thrust Belt has been explored for oil and gas since 1903 when the first oil well was drilled. Thrusting of the Paleozoic and Mesozoic sedimentary rock in the study area has thickened formations, formed anticlines, and has thrust beds over structures that could result in oil and gas traps. The Nugget Sandstone and Twin Creek Limestone have produced oil and gas elsewhere in the thrust belt. Monley (1971, p. 522) gives the thickness of 1,630 ft for the Twin Creek Limestone in the Fall Creek area. Six oil and gas leases covered large portions of the study area. Anschutz Corporation was the majority owner of each of the ten-year leases, all of which expired in 1991.

Two oil wells have been drilled into the Big Elk anticline just east of Big Elk Mountain. In 1949-50 Sun-Sinclair drilled one of the wells 5,597 ft deep in sec. 23, T. 2 S., R. 44 E. and abandoned it. In 1963 Pan American Petroleum Corp. re-entered the drill-hole, probably to re-log the strata. Later in the same year Pan American Petroleum Corp. drilled the other well, 9,719 ft deep, on the Big Elk anticline in sec. 24, T. 2 S., R. 44 E. This well also was plugged and abandoned. Both wells were spudded in Triassic-age Ankareh Shale and both penetrated Mississippian strata. Six other wells have been drilled near the study area, two to the north and four to the south; the deepest was 16,600 ft. All the drill holes have been plugged and abandoned.

CONCLUSIONS

About 95% of all phosphate mined in the world is used to make fertilizer. As the world population increases the demand for phosphate will continue to increase. When phosphate reserves in Florida, North Carolina, and elsewhere in southeastern Idaho are depleted, phosphate resources in the study area will likely be mined. The average mill feed for phosphate in the western United States is 22.2% P_2O_5 (U.S. Bureau of Mines, 1987, p. 218), which is less than the average grade of many of the phosphate beds in the study area. However, the thin and steeply dipping phosphate beds in the study area although of mineable grade, are currently uneconomic to mine by the necessary high-cost, underground mining methods.

Travertine will continue to be mined from the Fall Creek Quarry adjacent to the study area. Used exclusively for dimension stone, the amount to be mined in the future will depend on the economy, and particularly the building industry. The travertine is not white enough or pure enough to be used in the special use or high value categories of limestone such as chemical, pulp and paper, and the deposit is too distant from population centers to produce limestone for the more common uses.

Gold placers along McCoy Creek may be too low grade to mine although there is sufficient quantity of gravel. Sample 230 contained $33.96 in gold/yd^3 of gravel; it was the only sample of undisturbed gravel that contained over $1.00/yd^3 of the 34 placer samples collected by the USBM. The other 33 averaged $0.33/yd^3, and 25 samples collected by the Forest Service averaged $0.05/yd^3. Four other samples (235-238) collected by the Forest Service and analyzed in the USBM laboratory averaged $1.79/yd^3. Sample 230 indicates there are small high-grade pockets or streaks of gold along McCoy Creek, but searching for and selectively mining these pockets and streaks would be expensive.

The gold-bearing gravel has a sticky-clay content that almost certainly results in a low gold recovery, both in sampling and in production runs. This factor may explain the relatively high gold content of the placer tailings and the stripped overburden, compared to gold concentration of in-place material. The clay content may have also been partially responsible for the failure of prior efforts to mine the placers.

The coal bed in the Fall Creek area is of insufficient tonnage or quality to mine. The uranium in the coal grades 0.02%, which is too low to mine.

Oil and gas resources was not investigated by USBM personnel in the field. Sandberg (1983, p. F2) places a high potential for oil and gas in the study area based on geology, structure, and drill hole data.

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Appendix A.-- Descriptions and chemical analyses of rock samples from the Bear Creek-Poker Peak study area, Bonneville County, ID.

[Au, gold; Ag, silver; As, arsenic; Ba, barium; Cu, copper; Hg, mercury; Mn, manganese; Mo, molybdenum; Pb, lead; Sb, antimony; V, vanadium; W, tungsten; Zn, zinc]

[NA, not applicable; <, less than; --, not analyzed]

Sample Number	Figure Number	Sample Type	Length (ft)	Description	Au (ppb)	Ag (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	As (ppm)	Sb (ppm)	W (ppm)	Mn (ppm)	Ba (ppm)	Mo (ppm)	Hg (ppb)	V (ppm)
1	2	Grab	NA	Dark grey carbonaceous shale with 80 counts per second	<5	0.2	8	7	34	20	<5	<10	355	260	5	40	13
2	2	Chip	2.9	Dark grey carbonaceous silty fissile shale	<5	0.2	20	10	83	7	<5	<10	40	185	<1	40	16
3	2	Random	NA	Brownish grey fossiliferous limestone	<5	0.1	6	2	22	<5	<5	<10	82	170	<1	10	--
4	2,4	Grab	NA	Dark grey to black siliceous shale	<5	0.1	7	2	21	<5	<5	<10	95	<100	2	15	4
5	2,4	Select	NA	Same as sample 4 but contains abundant fossil remains	5	1.4	9	4	203	<5	<5	<10	20	<100	3	60	37
6	2	Random	NA	Light grey vuggy tufa coating organic plant material	<5	<0.1	11	<2	65	<5	<5	<10	85	<100	1	35	--
7	2	Select	NA	Calcite cemented clay from placer sample 233	<5	0.1	7	4	41	<5	<5	<10	1150	440	<1	20	--
108	2	Random	NA	Grey fine-grained thinly bedded limy mudstone	<5	0.1	10	10	23	7	<5	<10	370	<100	1	<10	--
109	2,3	Chip	3.3	Black oolitic phosphatic shale, poorly indurated	15	16	192	12	2040	25	14	22	18	<100	90	1350	960
110	2,3	Grab	NA	Black siliceous shale	<5	0.3	4	8	81	5	<5	<10	90	<100	2	<10	10
111	2,3	Chip	3.4	Do..	<5	0.2	4	10	45	<5	<5	<10	86	<100	1	<10	8
112	2,3	Select	NA	Do..	<5	0.1	3	18	28	<5	<5	<10	62	175	2	<10	13
113	2,3	Chip	5.1	Dark grey to black medium-bedded siltstone	<5	0.2	4	7	52	8	<5	<10	190	<100	2	10	--
114	2,3	Do..	1.0	Brown massive dolomite	<5	0.3	3	4	57	12	<5	<10	63	<100	2	15	18
115	2,3	Do..	1.5	Dark grey to black phosphatic shale containing oolites and fossil hash	<5	1.4	9	9	190	10	<5	<10	32	<100	2	60	48
116	2,3	Do..	1.9	Do..	<5	3.3	16	10	320	14	<5	<10	18	<100	12	85	90
117	2,3	Do..	9.0	Thin-bedded fissile shale containing thin beds of dolomite	<5	5.9	60	18	1925	35	17	25	93	<100	115	210	1375
118	2,3	Select	NA	Dark grey to black phosphatic shale containing oolites and fossil hash	5	3.8	34	8	340	8	<5	<10	15	<100	14	75	142

Appendix A.-- Descriptions and chemical analyses of rock samples from the Bear Creek-Poker Peak study area, Bonneville County, ID.--Continued

Sample Number	Figure Number	Sample Type	Length (ft)	Description	Au (ppb)	Ag (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)	As (ppm)	Sb (ppm)	W (ppm)	Mn (ppm)	Ba (ppm)	Mo (ppm)	Hg (ppb)	V (ppm)
119	2,3	Select	NA	Fossiliferous phosphatic shale containing brachiopods up to 1/2 in.	<5	1.6	7	7	192	7	<5	<10	36	<100	4	45	60
120	2,3	Chip	6.1	Dark grey to black phosphatic shale containing oolites and fossil hash	<5	11	92	10	1540	18	8	18	88	<100	102	280	990
121	2,3	Select	NA	Do..	<5	1.7	9	8	260	10	<5	<10	52	<100	3	350	56
122	2,3	Do..	NA	Do..	10	5.4	43	5	273	5	5	<10	10	<100	2	165	325
123	2,3	Grab	NA	Subtransparent to opaque iron oxide-stained quartz in phosphatic shale	<5	0.1	4	9	24	<5	<5	<10	44	100	1	<10	11
124	2,3	Select	NA	Dark grey to black phosphatic shale containing oolites and fossil hash	<5	0.3	13	6	230	7	5	<10	22	<100	8	35	125
125	2	Random	NA	Dark grey fine-grained limestone	5	0.2	7	<2	21	<5	<5	<10	215	<100	<1	<10	--
126	2,4	Select	NA	Dark grey to black phosphatic shale containing oolites and fossil hash assaying 3.15% fluorine	<5	2.2	8	4	205	15	6	<10	28	110	2	75	37
127	2,4	Do..	NA	Siltstone with vugs of green secondary calcite assaying 0.40% fluoriue	<5	0.1	3	<2	82	<5	<5	<10	605	<100	<1	<10	16
128	2,4	Do..	NA	Brecciated siltstone with fractures filled with silica and fluorite assaying 1.27% fluorine	<5	0.4	3	2	71	6	<5	<10	93	<100	1	<10	15
129	2,4	Do..	NA	Dark grey to black phosphatic shale with oolites and fossil hash	12	1.3	10	6	185	7	<5	<10	30	200	1	50	42
130	2,4	Do..	NA	Light grey massive chert	<5	<0.1	3	4	35	<5	<5	<10	125	<100	<1	<10	4
131	2,3	Random	NA	Medium grey fossiliferous limestone	<5	0.1	4	<2	44	<5	<5	<10	405	<100	<1	<10	8
132	2,3	Chip	3.6	Dark grey to black shale with lenses of dolomite and limestone	15	18	215	22	2680	28	30	15	27	<100	260	165	1230
133	2,3	Select	NA	Dark grey to black phosphatic shale with variscite	7	2.5	18	4	330	5	5	<10	22	<100	2	20	53
134	2,3	Random	NA	Dark grey limestone with fracture surfaces coated with secondary calcite	<5	<0.1	2	<2	39	<5	<5	<10	92	<100	<1	<10	6
135	2,3	Grab	NA	Dark grey to black phosphatic shale with oolites and fossil hash	<5	1.7	15	12	40	7	<5	<10	15	<100	5	45	41

APPENDIX B.--Whole rock analyses of samples from the Bear Creek-Poker Peak study area, Bonneville County, ID.

[Al_2O_3, aluminum oxide; CaO, calcium oxide; Fe_2O_3, iron oxide; K_2O, potassium oxide; MgO, magnesium oxide; MnO, manganese oxide NaO, sodium oxide; SiO_2, silicon oxide; LOI, loss on ignition; all concentrations in weight %]

Sample Number	Figure Number	Sample Type	Length (ft)	Description	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	Na_2O	K_2O	TiO_2	P_2O_5	MnO	LOI
4	2,4	Grab	NA	Dark grey to black siliceous shale	92.30	0.62	0.63	1.02	2.48	0.06	0.24	0.06	0.53	0.009	2.38
5	2,4	Select	NA	Same as sample 4 but contains abundant fossil remains	23.15	0.71	0.35	0.19	44.30	0.04	0.19	0.03	30.25	0.002	0.28
101	2	Random	NA	Medium grey fine-grained limestone	11.50	3.21	0.89	1.23	45.20	0.78	0.41	0.11	0.12	0.021	36.4
102	2	Do..	NA	Dark grey fine-grained dolomitic limestone	21.65	1.73	0.57	1.91	40.15	0.47	0.15	0.05	0.10	0.12	33.25
103	2	Do..	NA	Medium grey fine-grained fossiliferous limestone	26.30	1.50	0.68	2.01	38.50	0.05	0.07	0.04	0.16	0.17	31.05
104	2	Do..	NA	Light grey fine-grained limestone	20.72	1.05	0.47	17.85	25.10	0.05	0.03	0.02	0.07	0.048	34.15
105	2	Do..	NA	Dark grey fine-grained limestone	7.13	1.85	0.58	0.97	49.10	0.42	0.19	0.05	0.06	0.031	39.10
106	2	Do..	NA	Light buff to white massive travertine	0.35	0.12	0.03	0.21	55.35	0.01	0.01	<0.01	0.01	0.009	43.45
107	2	Do..	NA	Do..	0.75	0.21	1.52	0.72	54.10	0.02	0.03	<0.01	0.05	0.18	42.80
108	2	Do..	NA	Grey fine-grained thinly bedded limy mudstone	24.53	7.62	2.74	2.12	37.45	0.21	1.72	0.31	0.10	0.061	23.40
109	2,3	Do..	NA	Black oolitic phosphatic shale, poorly indurated	16.45	3.71	1.73	1.08	38.65	0.53	1.05	0.14	23.70	0.003	13.25
110	2,3	Grab	NA	Black siliceous shale	78.30	0.98	0.53	1.02	10.70	0.11	0.23	0.04	6.12	0.009	2.60
111	2,3	Chip	3.4	Do..	76.45	1.47	0.52	3.53	8.31	0.04	0.35	0.06	0.76	0.010	9.05
112	2,3	Select	NA	Do..	94.30	0.32	0.97	0.08	2.25	0.03	0.09	0.01	0.69	0.076	1.43
113	2,3	Chip	5.1	Dark grey to black medium-bedded siltstone	77.25	1.35	0.71	3.83	7.62	0.05	0.30	0.06	0.78	0.025	8.75
114	2,3	Do..	1.0	Brown massive dolomite	28.40	1.12	0.36	15.65	23.60	0.07	0.15	0.04	0.52	0.11	30.25
115	2,3	Do..	1.5	Dark grey to black phosphatic shale containing oolites and fossil hash	23.50	0.81	0.42	0.54	44.15	0.34	0.21	0.03	25.80	0.006	4.03
116	2,3	Do..	1.9	Do..	11.03	1.92	0.76	0.34	49.20	0.59	0.40	0.11	29.90	0.003	4.75
117	2,3	Do..	9.0	Thin-bedded fissile shale containing thin beds of dolomite	49.65	8.52	3.41	2.63	15.75	0.62	2.45	0.54	7.50	0.018	9.40
118	2,3	Select	NA	Dark grey to black phosphatic shale containing oolites and fossil hash	11.70	0.73	0.28	0.23	50.20	0.65	0.21	0.03	30.45	0.003	4.48

APPENDIX B.--Whole rock analyses of samples from the Bear Creek-Poker Peak study area, Bonneville County, ID.--Continued

Sample Number	Figure Number	Sample Type	Length (ft)	Description	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	Na_2O	K_2O	TiO_2	P_2O_5	MnO	LOI
119	2,3	Select	NA	Fossiliferous phosphatic shale containing brachiopods up to 1/2 in.	10.25	0.85	0.42	0.25	51.35	0.38	0.19	0.03	31.20	0.007	4.82
120	2,3	Chip	6.1	Dark grey to black phosphatic shale containing oolites and fossil hash	19.70	4.82	1.93	11.05	24.95	0.20	1.33	0.22	6.50	0.017	29.50
121	2,3	Select	NA	Do..	7.23	0.53	0.38	0.29	52.80	0.43	0.17	0.03	32.10	0.010	3.76
122	2,3	Do..	NA	Do..	13.60	0.75	0.14	0.16	49.85	0.65	0.16	0.01	29.35	0.002	3.27
123	2,3	Grab	NA	Subtransparent to opaque iron oxide-stained quartz in phosphatic shale	96.45	0.23	0.56	0.01	0.58	0.02	0.06	<0.01	0.46	0.005	0.48
124	2,3	Select	NA	Dark grey to black phosphatic shale containing oolites and fossil hash	16.20	1.42	0.39	0.21	48.30	0.41	0.29	0.04	27.90	0.004	3.80
125	2	Random	NA	Dark grey fine-grained limestone	7.85	2.95	1.23	1.10	49.05	0.09	0.53	0.07	0.18	0.034	37.90
126	2,4	Select	NA	Dark grey to black phosphatic shale containing oolites and fossil hash assaying 3.15% fluorine	27.20	0.62	0.29	0.62	40.35	0.40	0.14	0.01	24.80	0.007	3.87
127	2,4	Do..	NA	Siltstone with vugs of secondary green calcite assaying 0.40% fluorine	66.05	0.33	0.18	0.81	18.50	0.01	0.05	<0.01	0.81	0.11	13.67
128	2,4	Do..	NA	Brecciated siltstone with silica fractures containing fluorite assaying 1.27% fluorine	75.81	0.41	0.29	2.35	8.93	0.03	0.11	0.01	2.65	0.016	8.10
129	2,4	Do..	NA	Dark grey to black phosphatic shale with oolites and fossil hash	15.75	0.66	0.24	0.19	50.80	0.38	0.14	0.01	28.10	0.005	4.02
130	2,4	Do..	NA	Light grey massive chert	95.10	0.37	0.30	0.01	1.69	0.02	0.11	0.01	1.27	0.014	0.63
131	2,3	Random	NA	Medium grey fossiliferous limestone	28.65	1.03	0.11	0.41	39.50	0.04	0.20	0.02	1.65	0.058	28.50
132	2,3	Chip	3.6	Dark grey to black shale with lenses of dolomite and limestone	31.50	7.15	2.34	1.63	29.80	0.36	1.86	0.25	1.32	0.005	23.45
133	2,3	Select	NA	Dark grey to black phosphatic shale with variscite	10.35	0.72	0.26	0.25	52.10	0.43	0.17	0.02	31.20	0.003	4.25

APPENDIX B.--Whole rock analyses of samples from the Bear Creek-Poker Peak study area, Bonneville County, ID.--Continued

Sample Number	Figure Number	Sample Type	Length (ft)	Description	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	Na_2O	K_2O	TiO_2	P_2O_5	MnO	LOI
134	2,3	Random	NA	Dark grey siltstone with fracture surfaces coated with secondary calcite	88.60	0.97	0.43	1.26	3.61	0.06	0.24	0.05	0.63	0.013	3.78
135	2,3	Grab	NA	Dark grey to black phosphatic shale with oolites and fossil hash	25.70	1.45	0.41	0.24	43.20	0.37	0.33	0.05	26.05	0.004	2.71

APPENDIX C.--Descriptions and analyses of placer samples from the Bear Creek-Poker Peak study area, Bonneville County, ID.

[Mg, milligram, a gold price of $353/oz was used in the calculations]

Sample No. fig. 5	Description	Volume (yd^3)	Gold weight (mg)	Gold value ($/$yd^3$)	Black sand (lb/yd^3)	Magnetite content (lb/yd^3)
201	Gravel from stream bed; gold bright and subangular	0.008	0.814	1.16	0.45	13.79
202	Old dredge tailings with abundant clay; gold is subrounded to angular.	.008	1.425	2.02	.04	10.00
203	Do..	.008	.746	1.06	1.36	13.66
204	Do..	.008	.588	.84	.61	14.59
205	Material from 18 in.-thick seam of gravel; gold is bright and angular.	.008	.596	.85	.17	13.91
206	Old dredge tailings with abundant clay	.037	0	0	.01	2.53
207	Gravel from stream bank	.008	.566	.80	.24	11.91
208	Old dredge tailings with abundant clay	.008	0	0	.22	12.32
209	Do..	.008	0	0	.28	12.85
210	Gravel from stream bed	.008	.311	.44	.09	9.90
211	Gravel from stream bank down to water level	.008	.484	.69	.08	9.70
212	Gravel from small bar consisting mostly of sedimentary rock	.008	0	0	.01	11.30
213	Gravel from stream bank consisting of sedimentary rock	.008	.296	.42	.07	10.17
214	Do..	.008	0	0	.07	13.38
215	Do..	.008	0	0	.06	13.06
216	Gravel from stream bank down to water level	.008	.039	.06	.21	13.57
217	From gravel bar consisting mostly of sedimentary rock fragments	.008	0	0	.03	12.72
218	Gravel from stream bank down to water level; gravel consists of sedimentary rock fragments.	.008	0	0	.02	11.48
219	Do..	.008	0	0	.02	13.93
220	Do..	.008	.114	.16	.45	10.73
221	Gravel from stream bank down to water level; gravel consists of sedimentary rock fragments.	0.008	0.044	0.06	0.51	17.34
222	From gravel bar consisting of sedimentary rock fragments	.008	0	0	.12	14.64

APPENDIX C.--Descriptions and analyses of placer samples from the Bear Creek-Poker Peak study area,Bonneville County, ID--Continued

Sample No. fig. 5	Description	Volume (yd^3)	Gold weight (mg)	Gold value ($/$yd^3$)	Black sand (lb/yd^3)	Magnetite content (lb/yd^3)
223	Gravel laying on vertically dipping limestone bedrock	.008	.252	.36	.12	10.73
224	Do..	.008	.690	.98	.07	12.40
225	Gravel from stream bank down to water level gravel consists mostly of sedimentary rock fragments	.008	0	0	.02	15.20
226	Do..	.008	0	0	.03	15.39
227	Gravel from shale bedrock	.008	.304	.43	.18	12.34
228	From gravel bar consisting of sedimentary rock fragments	.008	.452	.64	.15	15.10
229	Do..	.008	0	0	.04	12.47
230	Do..	.008	23.901	33.96	.11	9.67
231	Do..	.008	0	0	.01	14.41
232	Do..	.008	0	0	.08	18.47
233	From clay layer along bedrock	.037	.333	.10	.05	2.63
234	Gravel from stream bank down to water level; gravel consists mostly of sedimentary rock fragments	.037	0	0	.01	2.98
235	From hole 9 ft deep; the bottom 2 ft is a well sorted gravel bed with about 25% cobbles 6 to 8 in. on bedrock	.5	235.679	5.36	.01	.02
236	From hole 12 ft deep; 4 ft of gravel in the bottom with about 10% 6 in. cobbles	.5	14.511	.32	.07	.04
237	From hole 10 ft deep; clay layer at the 6 ft level	0.5	7.894	0.18	0.01	0.01
238	From hole 5 ft deep; 4 ft of gravel with 20% cobbles 6 in to 2 ft.	.5	58.242	1.32	.01	0.02

Appendix D.--Sample analysis from U.S. Forest Service patent examination

[Gold price of $520/oz used by Forest Service, gold price of $353 from Engineering and Mining Journal; Sample locations shown on figure 5.]

Sample No.	Gold Content Amalgamation (mg)	Sample Size (ft^3)	Dollars/yd^3 ($520.00 Gold)	Dollars/yd^3 ($353.00 Gold)
2284	1.26	2.0	0.28	0.19
2285	.14	4.5	.01	.01
2286	.13	3.0	.02	.01
2287	.33	2.0	.07	.05
2288	.70	1.0	.32	.21
2289	.09	1.0	.04	.03
2290	.05	1.0	.02	.02
2291	.05	1.0	.02	.02
2292	.06	1.0	.03	.02
2293	.96	2.0	.22	.15
2294	0	1.0	0	0
2295	.12	1.0	.05	.04
2296	Trace	1.0	0	0
2297	.15	1.0	.07	.05
2298	0	1.0	0	0
2299	.23	1.0	.10	.07
2300	Trace	1.0	0	0
2301	Trace	1.0	0	0
2302	.04	1.0	.02	.01
2303	.04	1.0	.02	.01
2304	0	1.0	0	0
2305	.43	1.0	.19	.13
2306	.44	1.0	.20	.13
2307	.04	1.0	.02	.01
2308	.17	1.0	.08	.05